Appendix 7-F

SEDIMENT POND CALCULATIONS

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COMPUTED CAB DATE 10/91
CHECKED ____ DATE ____

Pond A - Existing Structure

Stage - Area data

Elev. (ft.)	Area (ft²)	Δ vol (ft³)	Cumulative vol. (ft³)
7082	4826		0
		10,618	
7084	5792		10,618
		13,084	
7086	7292		23,702
		16,144	
7088	8852		39,846
		19,366	
7090	10,514		59,212
		22,247	
7092	11,733		81,459
		24,752	
7094	13,019		106,211
		6590	
7094.5	13,340		112,801
		20,765	
7096	14,347		133,566
		5792	
7096.4	14,613		139,358

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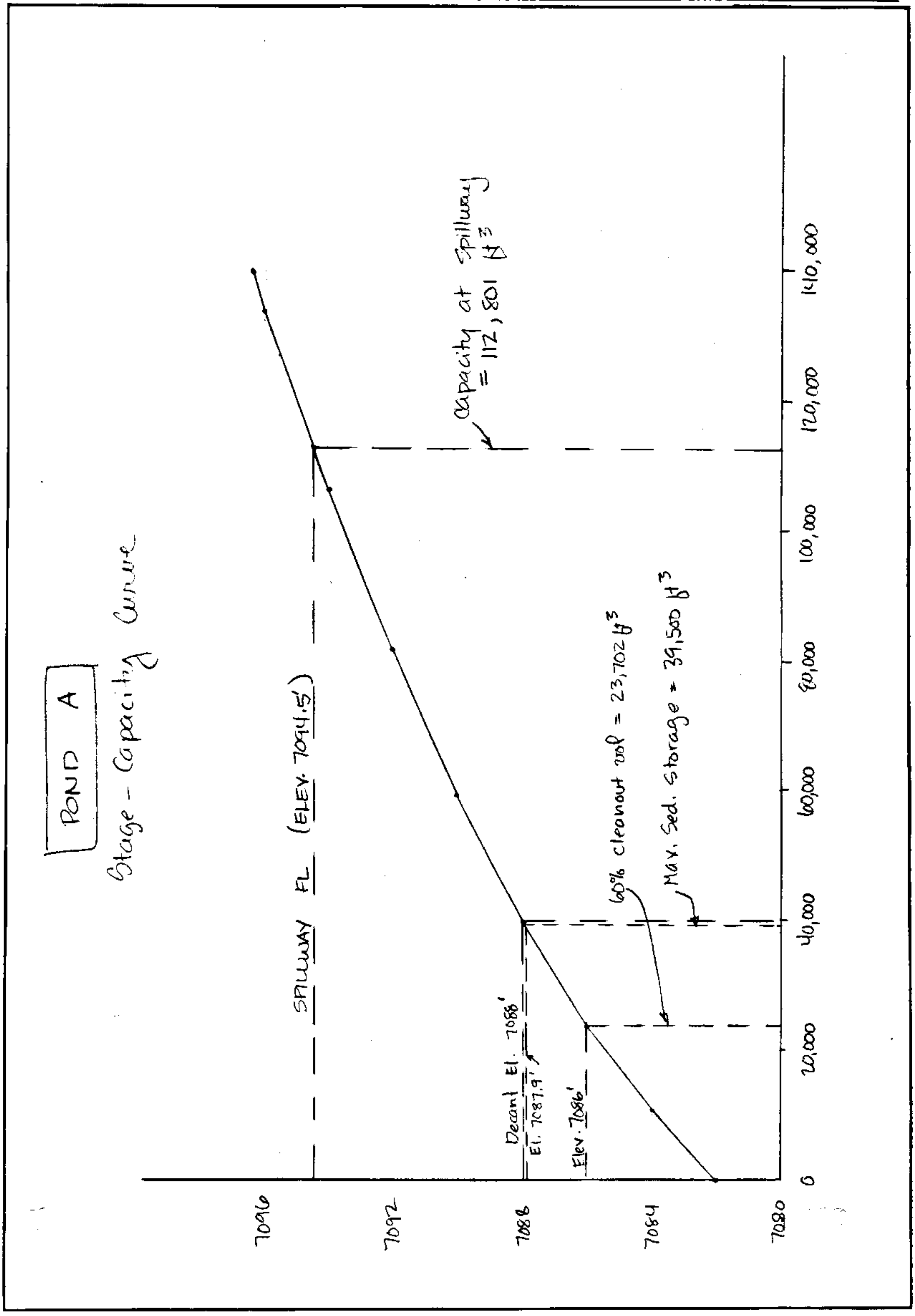
PROJECT UC192-08 PAGE 2 OF 51
COMPUTED CAB DATE 10/91
CHECKED DATE



Soil Erosion to Ponds A + B

Use the Modified Universal Soil Loss Equation:

$$A = R \cdot K \cdot LS \cdot VM$$

Ref: Israelsen, C.E., J.E. Fletcher, F.W. Haws, E.K. Israelsen. 1984. Erosion and Sedimentation in Utah: A Guide for Control. Utah Water Research Laboratory. Logan, Utah.

A = Amount of Soil Loss per Unit Area

R = Rainfall Factor

K = Soil Erodibility Factor

LS = topographic Factor

VM = erosion control factor = 1.2 for bare, compacted soil
= 0.1 for seeding + erosion

For Both Ponds →

R = 16 tons/Ac/Hr. (Mean Annual R value from Figure 1, (Israelsen et al, 1984))

K = 0.1 tons/Ac/EI (Israelsen et al, 1984)

$$LS = \left(\frac{650 + 4505 + 65S^2}{10{,}000 + S^2}\right)\left(\frac{l}{72.6}\right)^m$$

(Ref. Clyde, et al, 1978. Manual of Erosion Control Principles + Practices. Utah Water Research Laboratory. Logan, Utah)

l = Slope length
S = Slope Steepness

$$m = \begin{cases} .2 & \text{for } 0 < S < 1\% \\ .3 & \text{for } 1 < S < 3\% \\ .4 & \text{for } 3 < S < 5\% \\ .5 & \text{for } S > 5\% \end{cases}$$

POND A

Sediment Volumes

Drainage Area	Slope length ℓ (ft.)	Slope S (%)	LS	VM	A (tons/Ac/yr)	Area (Acres)	A [a] (ft³/year)
AD-1a	800	66	72.49	.1	11.6	3.70	858
AD-1b	150	95	47.6	.1	7.6	2.12	323
AD-2a	290	72	48.7	.1	7.79	0.97	151
AD-2b	320	59	39.47	.65 (brush + soil)	41.05	1.08	887
AD-2c	140	64	29.13	.65 (brush + soil)	30.29	0.25	151
AD-3a	400	70	55.24	.1	8.84	1.49	263
AD-3c	400	71	56.22	.1	9.00	0.78	140
AD-5	250	73	45.99	.1	7.36	2.13	314
AD-6	600	2	0.34	1.2	0.65	1.39	18
AD-7	1140	8	3.31	1.2	6.36	2.95	375
AD-8 upper	140	70	32.68	.35 (brush)	18.3	0.70	256
AD-8 lower	600	1	0.18	.9 (coal)	0.26	2.79	15
AD-9	420	7.2	1.74	1.2	3.34	0.35	23
AD-10 upper	130	34	10.93	.35 (brush)	6.12	0.30	37
AD-10 lower	200	2	0.25	1.2	0.47	0.65	6
AD-11	110	20	4.22	.6 (pond + undist.)	4.05	0.69	56
AD-12 upper	100	64	24.62	1.2	47.27	0.22	208
AD-12 lower	500	8	2.19	1.2	4.21	0.34	29
AD-14	75	61	20.00	1.2	38.4	0.08	61
							4171 ft³

(a) assume a soil unit weight of 100 lb/ft³

Storm Events

2 year - 6 hour P = 1.0

10 year - 6 hour P = 1.5

10 year - 24 hour P = 2.1

25 year - 6 hour P = 1.8

25 year - 24 hour P = 2.7

Curve Numbers

Disturbed area (pad, roads, etc) - CN = 90

Pond Area - CN = 100

Undisturbed areas - CN = 76

Areas w/ primarily brush only, CN = 83

Pond A

10-year, 24-hour runoff volume
Precip. = 2.1 inches

$Q = \frac{(P-0.2S)^2}{P+0.8S}$ $S = \frac{1000}{CN} - 10$

Watershed	CN	S	Q(in)	Area (Ac)	runoff vol. (ft³)
AD-1a	76	3.16	0.47	3.70	6313
AD-1b	76	3.16	0.47	2.12	3617
AD-2a	76	3.16	0.47	0.97	1655
AD-2b	83	2.05	0.76	1.08	2980
AD-2c	83	2.05	0.76	0.25	690
AD-3a	76	3.16	0.47	1.49	2542
AD-3b	76	3.16	0.47	0.78	1331
AD-5	76	3.16	0.47	2.13	3634
AD-6	90	1.11	1.18	1.39	5954
AD-7	90	1.11	1.18	2.95	12,636
AD-8	90	1.11	1.18	3.49	14,949
AD-9	90	1.11	1.18	0.35	1,499
AD-10	90	1.11	1.18	0.95	4,069
AD-11	95	.53	1.58	0.69	3957
AD-12	90	1.11	1.18	0.56	2399
AD-14	90	1.11	1.18	0.08	343

Total = 68,568 ft³

* Determine if Pond A will fully contain the runoff from the 10-year, 24-hour precipitation event ASSUMING the pond is full of water up to the decant elevation :

Decant elevation = 7088 ft
pond capacity @ decant = 39,846 ft^3

Pond capacity at Spillway FL = 112,801 ft^3
pond capacity at Decant FL = - 39,846 ft^3

Available runoff storage = 72,955 ft^3

Since the runoff volume from the 10-year, 24-hour storm is 68,568 ft^3 there is More than adequate Storage in the existing pond structure.

* Decant Elev. is 2' higher than the 60% sediment cleanout elevation. (Dave Alliotti, State Health Dept., Price Utah)

60% Cleanout elevation = 7086 ft vol = 23,702 ft^3

Maximum Sediment volume = $\frac{23,702}{.6}$ = 39,500 ft^3

Elev. of Max. Sediment volume = 7087.9'

Annual Sed. volume = 4,171 ft^3

Therefore, Pond A will provide many years of Sediment storage before cleanout is required.

Pond A

Sedimot II Data

	Watershed	CN	Area (Ac.)	Slope Y(%)	Hyd. length l (ft.)	$S = \frac{1000}{CN} - 10$	$L = \frac{l^{.8}(S+1)^{.7}}{1900Y^{.5}}$	$T_c = 1.67L$ Time of Conc. (Hr)
1	AD-1a	76	3.70	66	1300	3.16	.05	.09
20	AD-1b	76	2.12	95	520	3.16	.022	.037
2	AD-2a	76	0.97	72	440	3.16	.02	.04
3	AD-2b	83	1.08	59	320	2.05	.015	.025
4	AD-2c	83	0.25	64	140	2.05	.007	.012
5	AD-3a	76	1.19	70	400	3.16	.021	.034
6	AD-3b	76	0.78	71	400	3.16	.020	.034
7	AD-4	83	0.08	49	100	2.05	.007	.011
8	AD-5	76	2.13	73	760	3.16	.034	.056
9	AD-6	90	1.39	1.7	720	1.11	.131	.220
10	AD-7	90	2.95	8	1130	1.11	.087	.145
11	AD-8 upper	90	0.70	70	400	1.11	.013	.021
12	AD-8 lower	90	2.79	1.0	600	1.11	.148	.247
13	AD-9	90	0.35	7.2	420	1.11	.042	.069
14	AD-10 upper	90	0.30	34	320	1.11	.015	.026
15	AD-10 lower	90	0.65	2	220	1.11	.047	.078
16	AD-11	95	0.69	20	110	0.53	.007	.011
17	AD-12 upper	90	0.22	64	340	1.11	.012	.020
18	B.C. AD-12 lower	90	0.34	8	500	1.11	.045	5/92 .076
19	AD-14	90	0.08	61	120	1.11	.005	.009

Travel Times to Pond A

Watershed	Approx. slope to conveyance ditch	length of travel (ft.)	Velocity (ft/s)	Travel Time (Hr.)
AD-1a	3%	100	3.5	.01
AD-1b	10%	720	6.5	.03
AD-2a	12%	800	7	.03
AD-2b	35%	1060	12	.03
AD-2c	50%	1300	14	.03
AD-3a	S_1=73% S_2=7%	L_1=350 L_2=1360	V_1=17 V_2=5.3	.08
AD-3b	7%	1700	5.3	.09
AD-4 7110 - 7100	50%	1280	14	.03
AD-5	7%	1560	5.3	.08
AD-6	50%	1410	14	.03
AD-7	7%	1570	5.3	.08
AD-8 upper	7%	1300	5.3	.07
AD-8 lower	7%	1300	5.3	.07
AD-9	7.2%	540	5.5	.03
AD-10 upper	3%	350	3.5	.03
AD-10 lower	3%	150	3.5	.01
AD-11	—	0	—	0
AD-12 upper	—	0	—	0
AD-12 lower	—	0	—	0
AD-14	5%	450	4.5	.03

** Travel times based on Flow Velocities estimated from the Graph on following page (use paved area/small upland gullies).

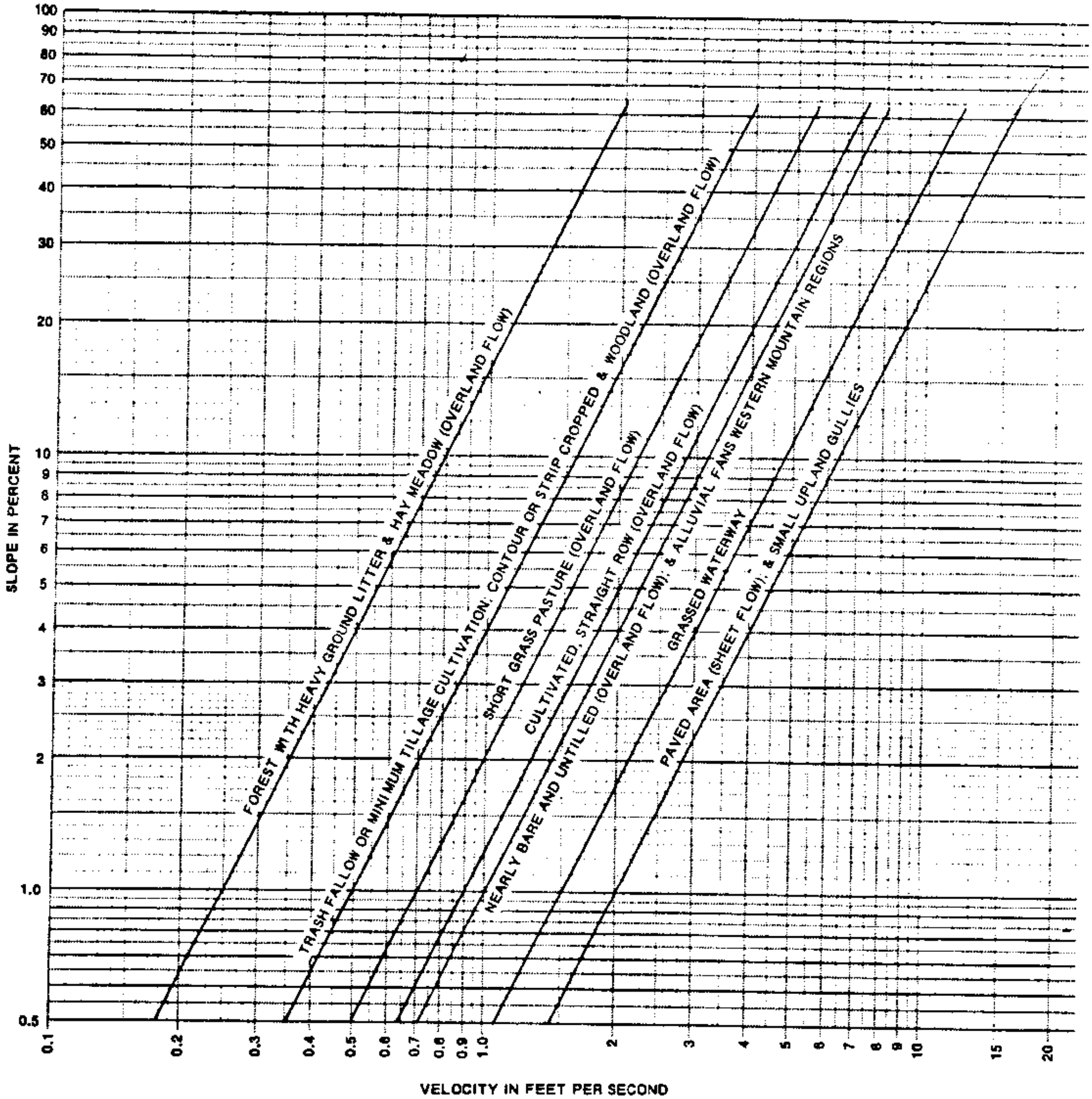


Figure 15.2.—Velocities for upland method of estimating T_c

* Use SCS Type B Distribution

* Note: In order to route hydrograph through the pond spillway, the Sedimentology option of Sedimot II must be used. Although some approximations for sediment data are required, the output is not required for the 25-year, 6-hour storm. Thus, only the Hydrologic data is valid. Disregard Sedimentology output!!

* 25-year, 6-hour storm = 1.8 inches

* Specific gravity of eroded sediment = 2.5
* Coef. for distributing Sed. Load = 1.5
* Submerged Bulk Specific gravity = 1.25

Grain Size Distribution:

Size (mm)	% Finer
.25	100
.10	50
.05	35
.01	19
.005	15
.001	6
.0001	0

7 values

* No. of Structures = 1 (pond)
* Between structures routing parameters → all ∅
* No. of Subwatersheds = 20
* MUSCLE data → all ∅
* % dead space → assume 20% (Not req'd for Hydrology)
* Outflow withdrawal → surface
* Inflow vertical concentration → mixed
* Enter Stage Data Assuming pond empty to Decant elevation.
* Enter Stage - discharge Curve for trap. Spillway.

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COMPUTED [illegible] DATE 10/91
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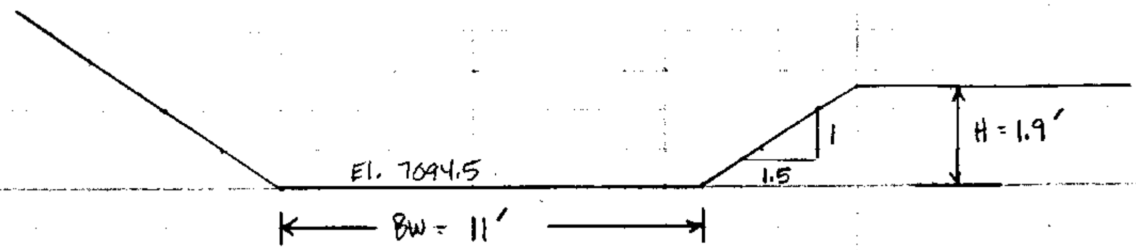
Rainfall Distribution = SCS Type B - 6 hour

P = 1.8 inches

Time (%)	Depth (%)	Time (hrs.)	Depth (in.)	30 min. Intensity
0	0	0	0	
				.06
8.33	3.5	0.5	0.06	
				.08
16.67	8.0	1.0	0.14	
				.10
25.0	13.5	1.5	0.24	
				.17
33.33	23.0	2.0	0.41	
				.67 ← Peak
41.67	60.0	2.5	1.08	
				.18
50.0	70.0	3.0	1.26	
				.14
58.33	78.0	3.5	1.40	
				.10
66.67	83.5	4.0	1.50	
				.09
75.0	88.5	4.5	1.59	
				.08
83.33	92.5	5.0	1.67	
				.07
91.67	96.5	5.5	1.74	
				.06
100.00	100.0	6.0	1.80	

POND A

Spillway Data (Not to Scale)



Average Riprap = 4" on bottom
10" on side slopes

$n = .0395 D_{50}^{1/6} = .036$ (Barfield, et al 1983)

Calculate a stage - discharge curve for the Spillway →

Based on a 100-foot wide rectangular section:

$q_r = (.544) g^{1/2} (H_{ec})^{1.5} (100) = 308.69 H_{ec}^{1.5}$

Using attached Figure: L = 10'

H_p (ft)	H_{ec} (ft)	q_r (ft³/s)
.5	.40	78.1
.8	.68	173.1
1.2	1.09	351.3
1.6	1.48	555.8
1.9	1.78	733.1

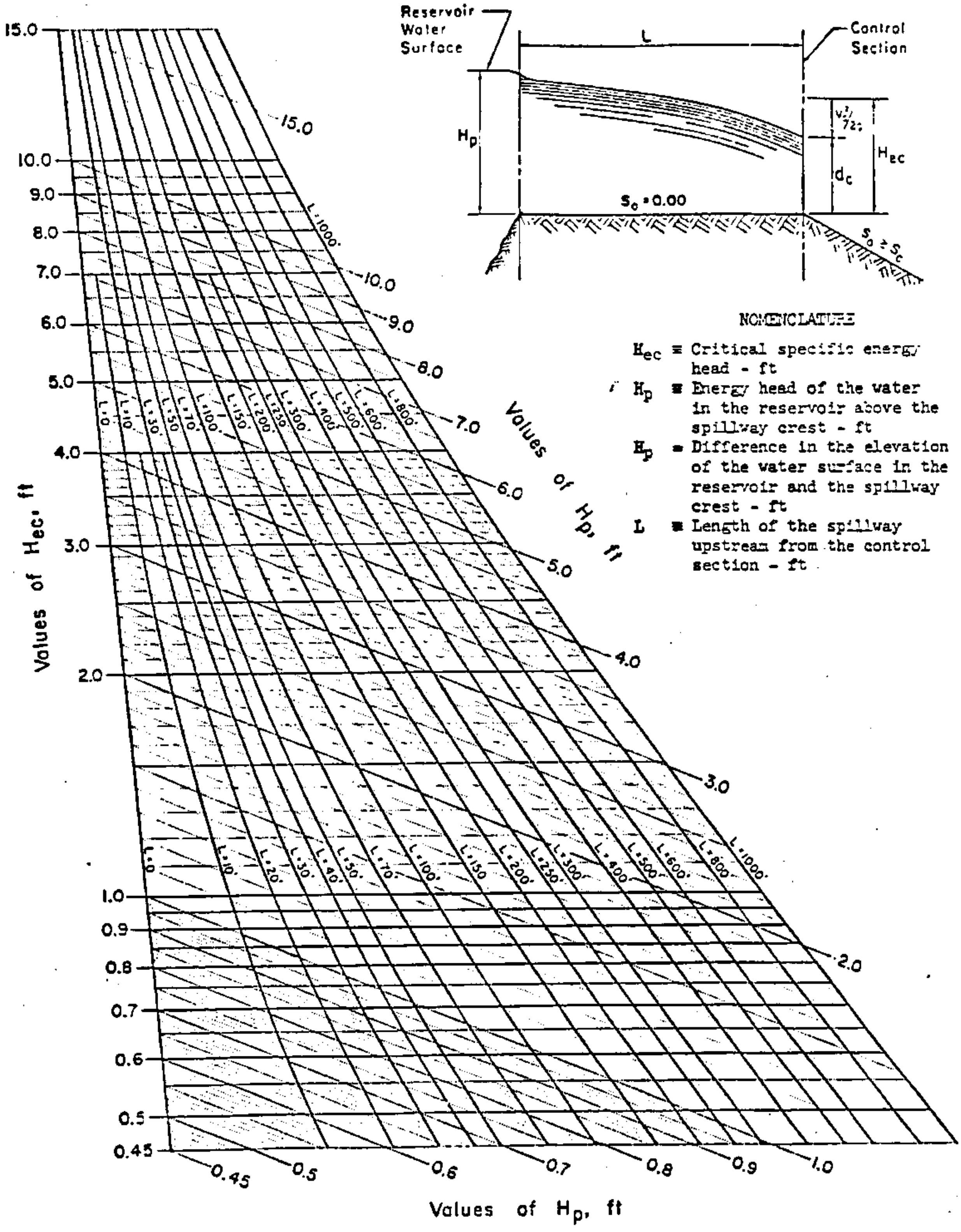
Convert to trapezoidal section by:

$$q_{trap} = \left[(1.5b + zH_{ec}) / 150 \right] (q_r)$$

b = bottom width = 11'
z = Side slope (run/rise) = $\frac{1.5}{1}$ = 1.5

Elev (ft.)	H_{ec} (ft)	q_r (ft³/s)	q_{trap} (cfs)
7094.5	0	0	0
7094.9	.40	78.1	8.90
7095.3	.68	173.1	20.22
7095.7	1.09	351.3	42.47
7096.1	1.48	555.8	69.36
7096.4	1.78	733.1	93.69

Note: Assume pond is empty of water to the spillway flowline when storm occurs.
This is conservative since the pond would likely be drained of water to the decant level.



Head relationships for selected broad-crest weirs
(from U.S. Soil Conservation Service, 1968)

Revise stage-capacity data for Sediment II.
Assume pond is full of sediment to the maximum sediment level + full of water up to the spillway flowline when storm event occurs

	Elevation	Stage	Area (ft^2)	Area (Ac)	Discharge (cfs)
Max. Sediment.	7087.9	0	8774	.201	0
Decant →	7088.0	.1	8852	.203	0
	7090.0	2.1	10,514	.241	0
	7092.0	4.1	11,733	.269	0
	7094.0	6.1	13,019	.299	0
Spillway FL →	7094.5	6.6	13,340	.306	0
	7094.9	7.0	13,609	.312	8.9
	7095.3	7.4	13,877	.319	20.2
	7095.7	7.8	14,146	.325	42.5
	7096.1	8.2	14,414	.331	69.4
Top of Embankment →	7096.4	8.5	14,613	.335	93.7

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*********************************************************************
                        -- SEDPC --
              SEDIMOT II MODEL FOR THE IBM PC/XT
              CONVERTED BY TECH ENGINEERING INC.
                VERSION 1.10 NOVEMBER 17,1983
*********************************************************************


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       UNIVERSITY OF KENTUCKY COMPUTER MODEL
       OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
       FOR MORE INFORMATION CONTACT THE AGRICULTURAL
       ENGINEERING DEPARTMENT

       THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
       THE HYDRAULIC AND SEDIMENT RESPONSE FROM SURFACE
       MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

       VERSION DATE 9-23-83

       DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
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       CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL

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*                                                                   *
*     THE FOLLOWING VALUES ARE NOW PREDICTED BY SEDIMOT II.         *
*     THEY CAN BE FOUND IN SUMMARY TABLES.                          *
*      1. PERIOD OF SIGNIFICANT CONCENTRATION                       *
*      2. VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION          *
*         DURING PERIOD OF SIGNIFICANT CONCENTRATION                *
*      3. VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION          *
*         DURING PEAK 24 HOUR PERIOD                                *
*      4. ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION               *
*         DURING PERIOD OF SIGNIFICANT CONCENTRATION                *
*      5. ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION               *
*         DURING PEAK 24 HOUR PERIOD                                *
*                                                                   *
*     ALL CONCENTRATIONS ARE IN ML/L.                               *
*                                                                   *
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`*********************************************`

WATERSHED IDENTIFICATION CODE

POND A - 25-YEAR, 6-HOUR STORM
SCS TYPE B STORM DISTRIBUTION
DRAINAGE AREA REVISION
RUN DATE = 7 MAY 1992

`*********************************************`

`********************` INPUT RAINFALL PATTERN `*******************`

VALUE	DEPTH	TIME
1	.00	.00
2	.06	.50
3	.14	1.00
4	.24	1.50
5	.41	2.00
6	1.08	2.50
7	1.26	3.00
8	1.40	3.50
9	1.50	4.00
10	1.59	4.50
11	1.67	5.00
12	1.74	5.50
13	1.80	6.00

INPUT PARTICLE SIZE-PERCENT FINER DISTRIBUTIONS

SIZE,MM	.250	.100	.050	.010	.005	.001
	.000					
PCT FINER NO. 1	100.000	50.000	35.000	19.000	15.000	6.000
	.000					

`*********************`INPUT VALUES`*******************`

STORM DURATION	=	6.00	HOURS
PRECIPATION DEPTH	=	1.80	INCHES
SPECIFIC GRAVITY	=	2.50	
LOAD RATE EXPONENT FACTOR	=	1.50	
SUBMERGED BULK SPECIFIC GRAVITY	=	1.25	

* *

JUNCTION 1, BRANCH 1, STRUCTURE 1

* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X	UNIT HYDRO
1	3.70	76.00	.090	.010	.000	.00	.0
2	.97	76.00	.040	.030	.000	.00	.0
3	1.08	83.00	.025	.030	.000	.00	.0
4	.25	83.00	.012	.030	.000	.00	.0
5	1.49	76.00	.034	.080	.000	.00	.0
6	.78	76.00	.034	.090	.000	.00	.0
7	.08	83.00	.011	.030	.000	.00	.0
8	2.13	76.00	.056	.080	.000	.00	.0
9	1.39	90.00	.220	.030	.000	.00	1.0
10	2.95	90.00	.145	.080	.000	.00	1.0
11	.70	90.00	.021	.070	.000	.00	.0
12	2.79	90.00	.247	.070	.000	.00	1.0
13	.35	90.00	.069	.030	.000	.00	.0
14	.30	90.00	.026	.030	.000	.00	.0
15	.65	90.00	.078	.010	.000	.00	.0
16	.69	95.00	.011	.000	.000	.00	.0
17	.22	90.00	.020	.000	.000	.00	.0
18	.34	90.00	.076	.000	.000	.00	.0
19	.08	90.00	.009	.030	.000	.00	.0
20	2.12	76.00	.037	.030	.000	.00	.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.00	.0	.00	.000	1.0	.0
2	1	.00	.0	.00	.000	1.0	.0
3	1	.00	.0	.00	.000	1.0	.0
4	1	.00	.0	.00	.000	1.0	.0
5	1	.00	.0	.00	.000	1.0	.0
6	1	.00	.0	.00	.000	1.0	.0
7	1	.00	.0	.00	.000	1.0	.0
8	1	.00	.0	.00	.000	1.0	.0
9	1	.00	.0	.00	.000	1.0	.0
10	1	.00	.0	.00	.000	1.0	.0
11	1	.00	.0	.00	.000	1.0	.0
12	1	.00	.0	.00	.000	1.0	.0
13	1	.00	.0	.00	.000	1.0	.0
14	1	.00	.0	.00	.000	1.0	.0
15	1	.00	.0	.00	.000	1.0	.0
16	1	.00	.0	.00	.000	1.0	.0
17	1	.00	.0	.00	.000	1.0	.0
18	1	.00	.0	.00	.000	1.0	.0
19	1	.00	.0	.00	.000	1.0	.0
20	1	.00	.0	.00	.000	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	1.02	.32	.00	.100	1.000	1.000
2	.27	.32	.00	.100	1.000	1.000
3	.59	.56	.00	.100	1.000	1.000
4	.14	.56	.00	.100	1.000	1.000
5	.41	.32	.00	.100	1.000	1.000
6	.21	.32	.00	.100	1.000	1.000
7	.04	.56	.00	.100	1.000	1.000
8	.59	.32	.00	.100	1.000	1.000
9	1.06	.93	.00	.081	.910	1.000
10	2.39	.93	.00	.087	.940	1.000
11	.62	.93	.00	.100	1.000	1.000
12	2.08	.93	.00	.079	.898	1.000
13	.31	.93	.00	.100	1.000	1.000
14	.27	.93	.00	.100	1.000	1.000
15	.58	.93	.00	.100	1.000	1.000
16	.81	1.29	.00	.100	1.000	1.000
17	.20	.93	.00	.100	1.000	1.000
18	.30	.93	.00	.100	1.000	1.000
19	.07	.93	.00	.100	1.000	1.000
20	.58	.32	.00	.100	1.000	1.000

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RATIO 2

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

RUNOFF VOLUME	=	1.1884	ACRE-FT
PEAK DISCHARGE	=	12.0044	CFS
AREA	=	23.0600	ACRES
TIME OF PEAK DISCHARGE	=	2.50	HRS
BETA	=	.0100	
RAINFALL EROSITIVITY FACTOR	=	9.59	EI UNIT
PEAK CONCENTRATION	=	.00	MG/L
PEAK SETTLEABLE CONCENTRATION	=	.00	ML/L
PEAK SETTLEABLE CONCENTRATION	=	.00	MG/L
TOTAL SEDIMENT YIELD	=	.0000	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0001	MM
TIME OF PEAK CONCENTRATION	=	.00	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	-6.80	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

* *

POND RESULTS

* *

***** CONTROL VARIABLES OPTIONS *****

FLOW	FRACTN	ISDO	NRHP	NSP	NCSTR
3	0	1	500	11	1

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	.201	.00	.00	.00
.10	.203	.10	.00	.02
2.10	.241	2.01	.00	.46
4.10	.269	3.88	.00	.97
6.10	.299	5.70	.00	1.54
6.60	.306	6.14	.00	1.69
7.00	.312	6.50	8.90	1.82
7.40	.319	6.85	20.20	1.94
7.80	.325	7.20	42.50	2.07
8.20	.331	7.55	69.40	2.20
8.50	.335	7.81	93.70	2.30

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	1.693	ACRE-FT
DEAD STORAGE	=	20.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	1.188	ACRE-FT
OUTFLOW ROUTED VOLUME	=	1.188	ACRE-FT
STORM VOLUME DISCHARGED (PLUG FLOW)	=	1.188	ACRE-FT
POND VOLUME AT PEAK STAGE	=	1.818	ACRE-FT
PEAK STAGE	=	7.002	FT
PEAK INFLOW RATE	=	12.004	CFS
PEAK DISCHARGE RATE	=	8.949	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	.00	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	.00	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0000	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.00	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	.00	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	.00	MG/L
BASIN TRAP EFFICIENCY	=	***********	PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	.17	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	.17	HRS
DETENTION TIME INCLUDING STORED FLOW	=	.17	HRS
SEDIMENT LOAD DISCHARGED	=	.00	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	-7.70	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

Pond A - Summary

25-year, 6-hour storm
P=1.8 in.

Inflow runoff volume = 1.19 Ac-ft
Outflow routed volume = 1.19 Ac-ft

Peak Stage = 7.00 (Elev. 7094.90')

Peak inflow = 12.0 cfs
Peak Discharge = 8.9 cfs

Freeboard = 1.50 ft.

Check Flow Capacity and Adequacy of Riprap on Inlet + outlet Structures ⇒

Pond A

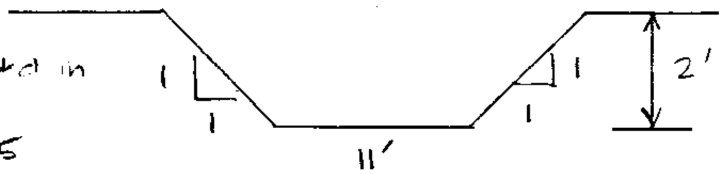
Inlet ⇒

Peak inflow = 11.4 cfs

Inlet is the entire access ramp to the pond. A small low-flow channel has been carved, but the whole ramp may be used for high flows. Assume the entire ramp is the inlet channel:

ramp constructed in Sediment.

$n = .035$



max Slope = $2'/10'$ = .20
Min Slope = $2'/10'$ = .20

resulting Velocity = 5.83 ft/s
resulting Depth = 0.17 ft OKAY ✓

Although the velocity can be considered erosive, the sediment will be contained by the pond, + is considered adequate. The channel will be maintained if excessive erosion occurs.

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: POND A

Comment: INLET WITH REVISED DRAINAGE AREA

Solve For Depth

Given Input Data:

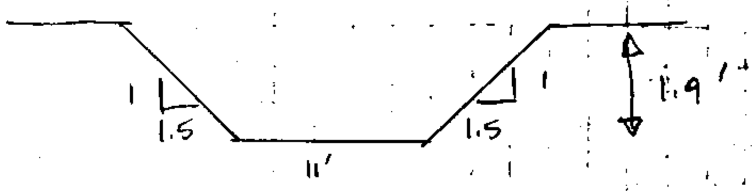
Bottom Width.....	11.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.2000 ft/ft
Discharge........	12.00 cfs

Computed Results:

Depth............	0.18 ft
Velocity.........	5.95 fps
Flow Area........	2.02 sf
Flow Top Width...	11.36 ft
Wetted Perimeter.	11.51 ft
Critical Depth...	0.33 ft
Critical Slope...	0.0269 ft/ft
Froude Number....	2.49 (flow is Supercritical)

Pond A - outlet

Peak $Q = 8.9$ cfs



D_{50} = 4" bottom
10" side slopes

$n = .0395 (D_{50})^{1/6}$
$= .036$

Max + Min slope = $6'/13' = .46$

resulting velocity = 6.68 ft/s
resulting depth = 0.12 ft

OKAY

Check riprap sizing ⇒
use attached figures:

assume K = 6" = .5 depth = d = .12

$\frac{K}{d} > 1$ ∴ $\frac{V_s}{V} = 1$ $V_s = V = 6.68$ ft/s

$d_{50} = .4$ ft ≐ 5" (for 2:1 slope)

existing riprap size is marginally adequate and will be maintained.

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: POND A

Comment: OUTLET WITH REVISED DRAINAGE AREA

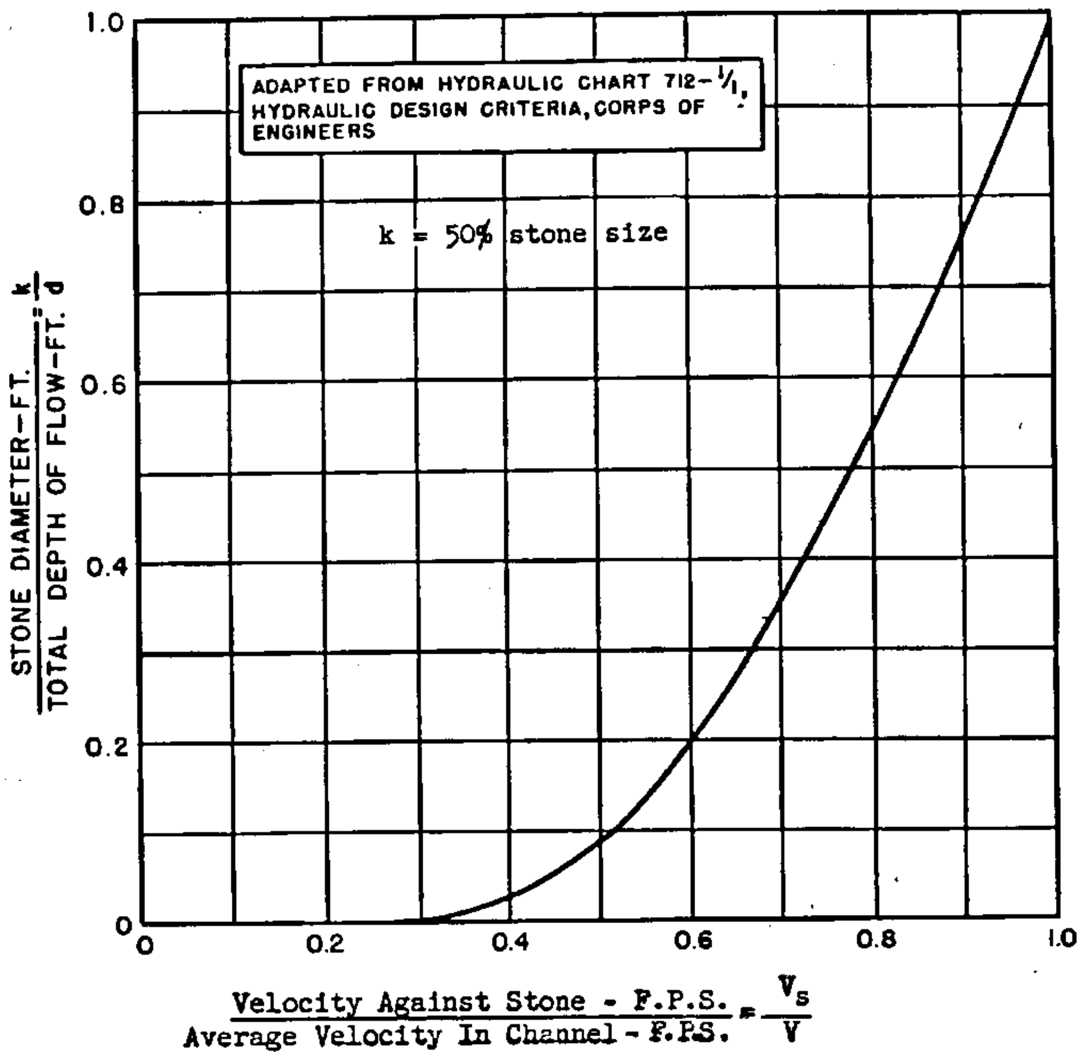
Solve For Depth

Given Input Data:

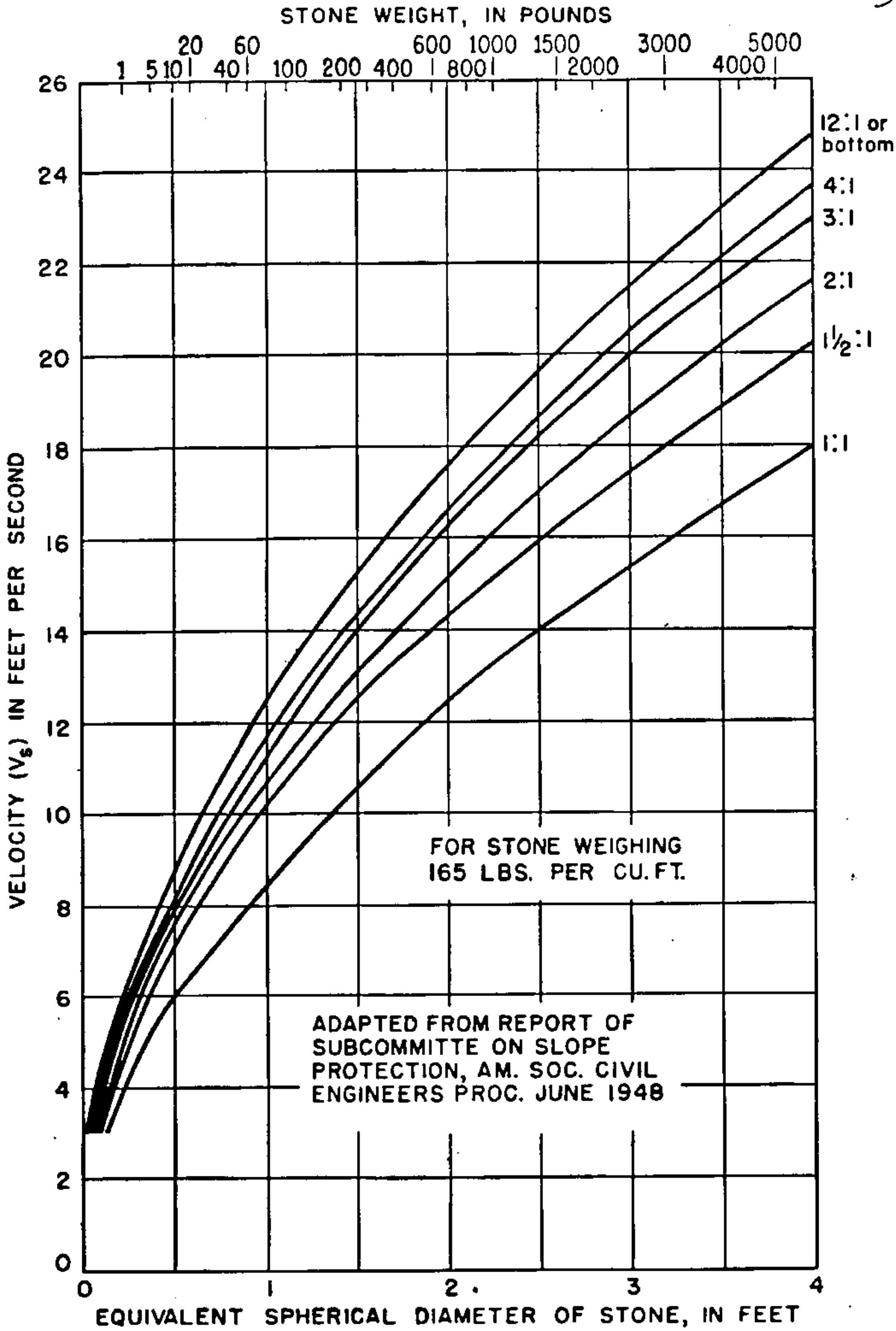
Bottom Width.....	11.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n......	0.036
Channel Slope....	0.4600 ft/ft
Discharge........	8.90 cfs

Computed Results:

Depth............	0.12 ft
Velocity.........	6.68 fps
Flow Area........	1.33 sf
Flow Top Width...	11.36 ft
Wetted Perimeter.	11.43 ft
Critical Depth...	0.27 ft
Critical Slope...	0.0301 ft/ft
Froude Number....	3.44 (flow is Supercritical)



Velocity Against Stone on Channel Bottom (U.S. Department of Transportation, 1978).



Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).

Pond E

Stage - Capacity Data

	Elev. (ft)	Area (ft²)	Δ vol (ft³)	cum. vol (ft³)
	7062	2350		0
			2609.5	
	7063	2869		2609.5
			3142.5	
	7064	3416		5752.0
			3711.0	
	7065	4006		9463.0
			4260.5	
	7066	4515		13,723.5
			4276.8	
Spillway FL →	7066.9	4989		18,000.3
			501.6	
	7067	5042		18,501.9
			5310.0	
Top of Embankment →	7068	5578		23,811.9

Decant elevation = 7064.9'

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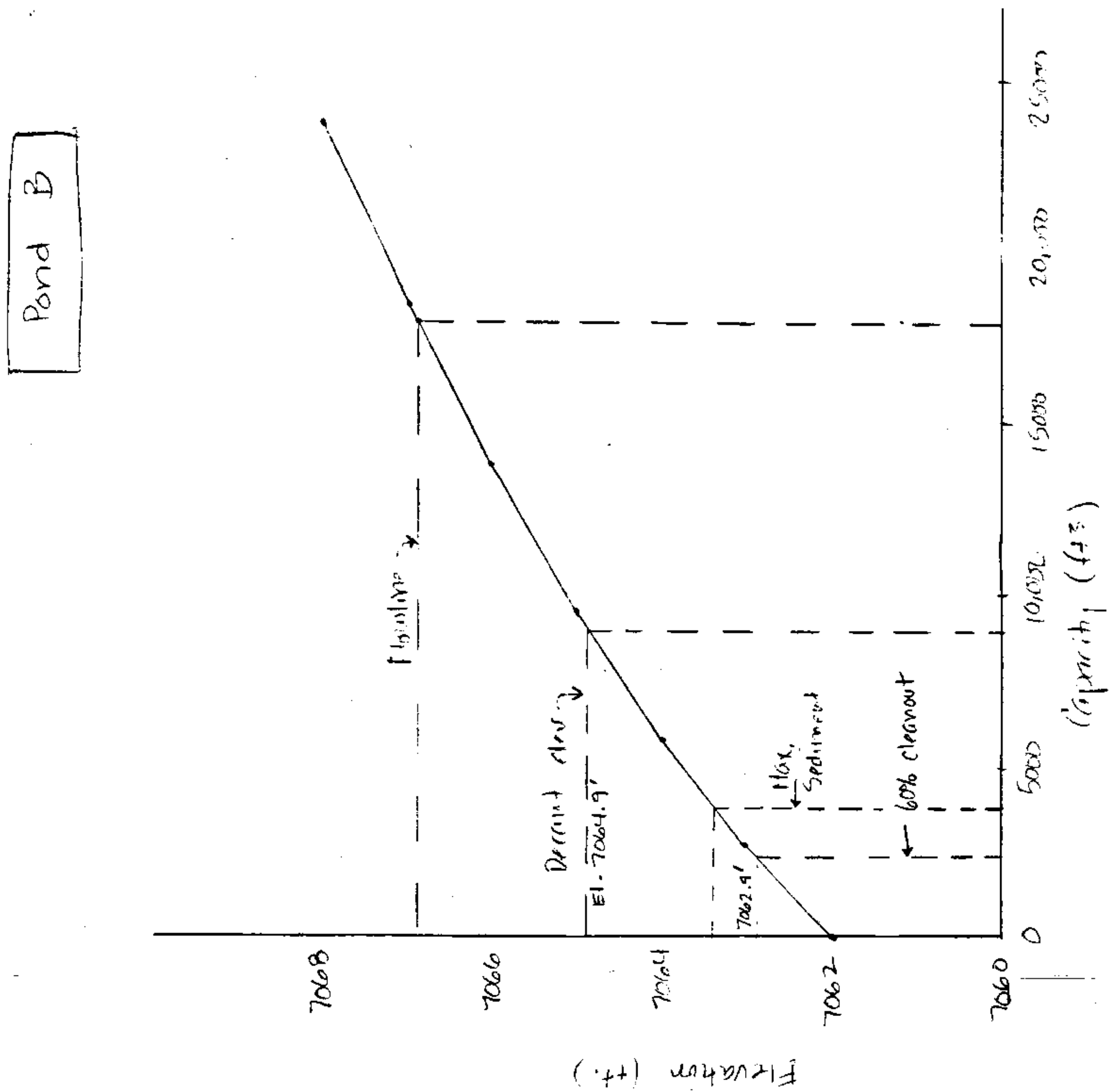
ENGINEERS / SCIENTISTS

PROJECT ____ PAGE 32 OF 51
COMPUTED ____ DATE 10/91
CHECKED ____ DATE ____



POND B

Disturbed Area AD-13 Contributes to Pond B.

$\lambda = 800'$
$S = 8\%$

$$LS = \left(\frac{650 + 450(8) + 65(8)^2}{10000 + 8^2}\right)\left(\frac{800}{72.6}\right)^{.5} = 2.77$$

$A = 16(.10)(2.77)(1.2) = 5.33$ tons/Ac/year

Area of AD-10 = 1.78 Acres = 77,540 ft^2

Unit wt. of Soil ~ 100 lbs/ft^3

$A = 190\ ft^3/year$

Runoff from 10-year, 24-hour storm:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad S = \frac{1000}{CN} - 10$$

CN = 90 for disturbed area
= 100 for pond surface.

$$\text{average CN} = \frac{5578\ ft^2(100) + 71,962\ ft^2(90)}{77,540\ ft^2} = 91$$

$S = \frac{1000}{91} - 10 = 0.99$ $\qquad$ P = 2.1 inches

$$Q = \frac{(2.1 - (.2)(.99))^2}{2.1 + (.8)(.99)} = 1.25 \text{ inches}$$

$$\text{Volume} = 1.25 \text{ in}\left(\frac{1 ft}{12 in}\right)\left(77,540\ ft^2\right) = 8077\ ft^3$$

Check to see if Pond B will fully contain the 10-year, 24-hour precipitation event ⇒

Capacity at Spillway = 18,000.3 ft^3
Capacity at Decant = $-$ 8,900.0 ft^3

Storage space for runoff = 9,100.3 ft^3

Since the runoff volume from the design storm is 8077 ft^3, the pond will <u>NOT</u> <u>Spill</u>.

Decant elevation = 7064.9'

60% cleanout elevation = 7062.9'

60% cleanout volume = 2,200 ft^3

Maximum Sediment volume = $\frac{2200}{.6}$ = 3670 ft^3

Maximum Sediment Elevation = 7063.4'

∴ The existing pond will provide many years of sediment storage with an adequate decant system.

Pond B

Sediment I Data:

Watershed AS-10 contributes to pond.

CN = 91
Area = 1.78 Acres
l = Hyd length = 800'
y = Ave Slope = 8%

$S = \frac{1000}{CN} - 10 = 0.99$

$L = \frac{l^{.8}(S+1)^{.7}}{1900 y^{.5}}$ $\quad$ $L = \frac{800^{.8}(1.99)^{.7}}{1900\sqrt{8}}$

$L = 0.063$

$T_c = 1.67L = 0.106$ hr.

* Use SCS Type B Distribution (See page 12 of this calc)

* Note: In order to route hydrograph through the pond spillway, the Sedimentology option of Sedimot II must be used. Although some approximations for sediment data are required, the output is not required for the 25-year, 6-hour storm. Thus, only the Hydrologic data is valid. Disregard Sedimentology output!!

* 25-year, 6-hour storm = 1.8 inches

* Specific gravity of eroded sediment = 2.5
* Coef. for distributing Sed. Load = 1.5
* Submerged Bulk Specific gravity = 1.25

Grain Size Distribution:

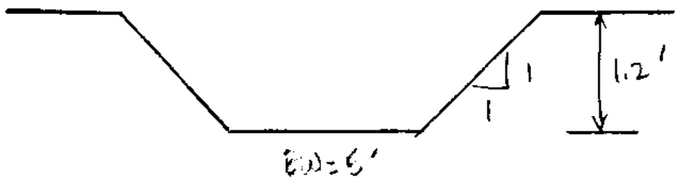
Size (mm)	% Finer
.25	100
.10	50
.05	35
.01	19
.005	15
.001	6
.0001	0

7 values

* No. of Structures = 1 (pond)
* Between structures routing parameters → all Ø
* No. of Subwatersheds = 1
* MUSCLE data → all Ø
* % dead space → assume 20% (Not req'd for Hydrology)
* Outflow withdrawal → surface
* Inflow vertical concentration → mixed
* Enter Stage Data Assuming pond empty to Decant elevation.
* Enter Stage - discharge curve for trap. Spillway.

POND E

SPILLWAY DATA (Not to Scale)



riprap $D_{50} \sim 6''$

calculate a Stage - discharge curve for the Spillway →
Based on a 100-foot wide rectangular Section:

$$q_r = (.544)\, g^{1/2}\, (H_{ec})^{1.5}\, (100) = 308.69\, H_{ec}^{1.5}$$

Using attached Figure: $L = 10'$

H_p (ft)	H_{ec} (ft)	q_r (ft^3/s)
.5	.40	76.1
.8	.63	173.1
1.1	0.98	299.5

convert to trapezoidal section:

$$q_{trap} = \left[(1.5b + zH_{ec}) / 150 \right] (q_r)$$

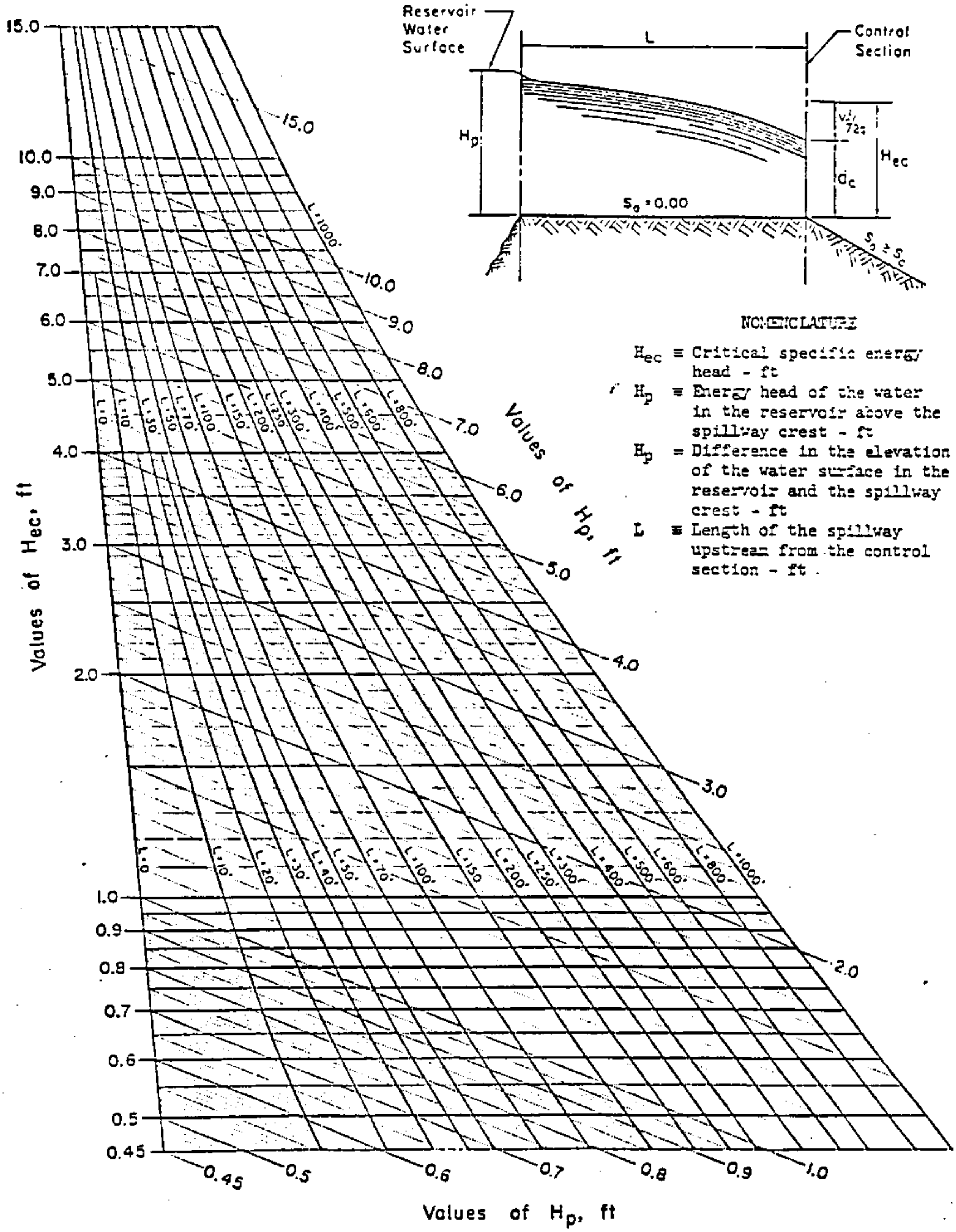
b = 5'
z = 1

Elev (ft.)	H_{ec} (ft)	q_r (ft³/s)	q_{trap} (cfs)
7066.9	0	0	0
7067.4	.4	78.1	4.11
7067.7	.68	173.1	9.44
7068.0	.98	299.5	16.93

Assume pond is full of water to spillway [illegible] when 25-year, 24-hour storm occurs.

Revised Stage - Discharge Curve ⇒

	Elevation (ft.)	Stage (ft)	Area (ft²)	Area (Ac.)	Discharge (cfs)
	7066.8	0	4927	.113	0
FL →	7066.9	.1	4989	.115	0
	7067.4	0.6	5256	.121	4.11
	7067.7	0.9	5417	.124	9.44
Top of Embankment	7068.0	1.2	5578	.128	16.93



NOMENCLATURE

H_{ec} ≡ Critical specific energy head - ft

H_p ≡ Energy head of the water in the reservoir above the spillway crest - ft

H_p = Difference in the elevation of the water surface in the reservoir and the spillway crest - ft

L ≡ Length of the spillway upstream from the control section - ft

Head relationships for selected broad-crest weirs (from U.S. Soil Conservation Service, 1968)

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*****************************************************************
                     -- SEDPC --
             SEDIMOT II MODEL FOR THE IBM PC/XT
             CONVERTED BY TECH ENGINEERING INC.
               VERSION 1.10 NOVEMBER 17,1983
*****************************************************************



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*****************************************************************

       UNIVERSITY OF KENTUCKY COMPUTER MODEL
       OF SURFACE MINE HYDROLOGY AND SEDIMENTOLOGY
       FOR MORE INFORMATION CONTACT THE AGRICULTURAL
       ENGINEERING DEPARTMENT

       THE UK MODEL IS A DESIGN MODEL DEVELOPED TO PREDICT
       THE HYDRAULIC AND SEDIMENT RESPONSE FROM SURFACE
       MINED LANDS FOR A SPECIFIED RAINFALL EVENT (SINGLE STORM)

       VERSION DATE 9-23-83

       DISCLAIMER: NEITHER THE UNIVERSITY NOR ANY OF ITS EMPLOYEES
       ACCEPT ANY RESPONSIBILITY OR LEGAL LIABILITY FOR THE
       CONCLUSIONS DRAWN FROM THE RESULTS OF THIS MODEL

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*****************************************************************
*                                                               *
*     THE FOLLOWING VALUES ARE NOW PREDICTED BY SEDIMOT II.     *
*     THEY CAN BE FOUND IN SUMMARY TABLES.                      *
*      1. PERIOD OF SIGNIFICANT CONCENTRATION                   *
*      2. VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION      *
*         DURING PERIOD OF SIGNIFICANT CONCENTRATION            *
*      3. VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION      *
*         DURING PEAK 24 HOUR PERIOD                            *
*      4. ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION           *
*         DURING PERIOD OF SIGNIFICANT CONCENTRATION            *
*      5. ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION           *
*         DURING PEAK 24 HOUR PERIOD                            *
*                                                               *
*     ALL CONCENTRATIONS ARE IN ML/L.                           *
*                                                               *
*****************************************************************
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****

WATERSHED IDENTIFICATION CODE

POND B - 25-YEAR, 6-HOUR STORM
SCS TYPE B DISTRIBUTION

****

*********************** INPUT RAINFALL PATTERN **********************

VALUE	DEPTH	TIME
1	.00	.00
2	.06	.50
3	.14	1.00
4	.24	1.50
5	.41	2.00
6	1.08	2.50
7	1.26	3.00
8	1.40	3.50
9	1.50	4.00
10	1.59	4.50
11	1.67	5.00
12	1.74	5.50
13	1.80	6.00

INPUT PARTICLE SIZE-PERCENT FINER DISTRIBUTIONS

SIZE,MM	.250	.100	.050	.010	.005	.001	.000
PCT FINER NO. 1	100.000	50.000	35.000	19.000	15.000	6.000	.000

***********************INPUT VALUES**********************

STORM DURATION	=	6.00	HOURS
PRECIPATION DEPTH	=	1.80	INCHES
SPECIFIC GRAVITY	=	2.50	
LOAD RATE EXPONENT FACTOR	=	1.50	
SUBMERGED BULK SPECIFIC GRAVITY	=	1.25	

* *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	AREA ACRES	CURVE NUMBER	TC HR	TT HR	ROUTING COEFFICIENTS K-HRS	X	UNIT HYDRO
1	1.78	91.00	.106	.000	.000	.00	.0

*** SEDIMENT INPUT VALUES FOR SUBWATERSHEDS ***

WATER SHED	SEG NUM	SOIL K	LENGTH FEET	SLOPE PCT	CP VALUE	PART OPT	SURF COND
1	1	.00	.0	.00	.000	1.0	.0

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

WATERSHED	PEAK FLOW (CFS)	RUNOFF (INCHES)	SEDIMENT TONS	DIAM (MM)	DELIVERY RATIO 1	DELIVERY RATIO 2
1	1.68	.99	.00	.100	1.000	1.000

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RATIO 2

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

RUNOFF VOLUME	=	.1469	ACRE-FT
PEAK DISCHARGE	=	1.6814	CFS
AREA	=	1.7800	ACRES
TIME OF PEAK DISCHARGE	=	2.50	HRS
BETA	=	1.0000	
RAINFALL EROSITIVITY FACTOR	=	9.59	EI UNIT
PEAK CONCENTRATION	=	.00	MG/L
PEAK SETTLEABLE CONCENTRATION	=	.00	ML/L
PEAK SETTLEABLE CONCENTRATION	=	.00	MG/L
TOTAL SEDIMENT YIELD	=	.0000	TONS
REPRESENTATIVE PARTICLE SIZE	=	.0001	MM
TIME OF PEAK CONCENTRATION	=	.00	HRS
PERIOD OF SIGNIFICANT CONCENTRATION	=	-6.00	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

* *

POND RESULTS

* *

***** CONTROL VARIABLES OPTIONS *****

FLOW	FRACTN	ISDO	NRHP	NSP	NCSTR
3	0	1	500	5	1

***** BASIN GEOMETRY *****

STAGE (FT)	AREA (ACRES)	AVERAGE DEPTH (FT)	DISCHARGE (CFS)	CAPACITY (ACRES-FT)
.00	.113	.00	.00	.00
.10	.115	.10	.00	.01
.60	.121	.59	4.11	.07
.90	.124	.89	9.44	.11
1.20	.128	1.18	16.93	.14

***** STORM EVENT SUMMARY *****

TURBULENCE FACTOR	=	1.00	
PERMANENT POOL CAPACITY	=	.011	ACRE-FT
DEAD STORAGE	=	20.00	PERCENT
TIME INCREMENT OUTFLOW	=	.10	HRS
VISCOSITY	=	.009	CM**2/SEC
INFLOW RUNOFF VOLUME	=	.147	ACRE-FT
OUTFLOW ROUTED VOLUME	=	.147	ACRE-FT
STORM VOLUME DISCHARGED (PLUG FLOW)	=	.147	ACRE-FT
POND VOLUME AT PEAK STAGE	=	.031	ACRE-FT
PEAK STAGE	=	.268	FT
PEAK INFLOW RATE	=	1.681	CFS
PEAK DISCHARGE RATE	=	1.381	CFS
PEAK INFLOW SEDIMENT CONCENTRATION	=	.00	MG/L
PEAK EFFLUENT SEDIMENT CONCENTRATION	=	.00	MG/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.0000	ML/L
PEAK EFFLUENT SETTLEABLE CONCENTRATION	=	.00	MG/L
STORM AVERAGE EFFLUENT CONCENTRATION	=	.00	MG/L
AVERAGE EFFLUENT SEDIMENT CONCENTRATION	=	.00	MG/L
BASIN TRAP EFFICIENCY	=**********		PERCENT
DETENTION TIME OF FLOW WITH SEDIMENT	=	.17	HRS
DETENTION TIME FROM HYDROGRAPH CENTERS	=	.17	HRS
DETENTION TIME INCLUDING STORED FLOW	=	.17	HRS
SEDIMENT LOAD DISCHARGED	=	.00	TONS
PERIOD OF SIGNIFICANT CONCENTRATION	=	-7.00	HRS
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
VOLUME WEIGHTED AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PERIOD OF SIGNIFICANT CONCENTRATION	=	.00	ML/L
ARITHMETIC AVERAGE SETTLEABLE CONCENTRATION DURING PEAK 24 HOUR PERIOD	=	.00	ML/L

*** RUN COMPLETED ****

Pond B - Summary

Inflow runoff volume = 0.15 Ac-ft
Outflow runoff volume = 0.15 Ac-ft

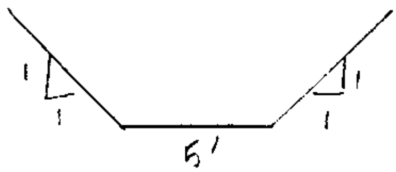
Peak inflow rate = 1.68 cfs
Peak outflow rate = 1.38 cfs

Peak Stage = 0.27' (Elev. 7067.07')

Freeboard = 0.93'

Pond B- outlet

Q peak = 1.38 cfs



d_{50} = 6"   n = .036

Min slope = max slope = 5'/12' = .42

resulting depth = .06 ft   okay
resulting velocity = 4.23 ft/s.   ok

Existing riprap is okay

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: POND B

Comment: POND B OUTLET

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n......	0.036
Channel Slope....	0.4200 ft/ft
Discharge........	1.38 cfs

Computed Results:

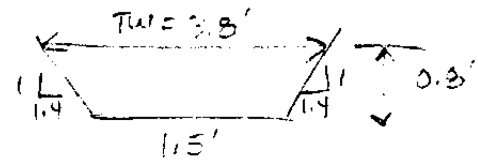
Depth............	0.06 ft
Velocity.........	4.23 fps
Flow Area........	0.33 sf
Flow Top Width...	5.13 ft
Wetted Perimeter.	5.18 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0385 ft/ft
Froude Number....	2.96 (flow is Supercritical)

Pond B - Inlets

* Inlet 1 : Adjacent to Road - grouted riprap.

Min Slope = Max Slope = 6'/9' = .67

BW = 1.5'



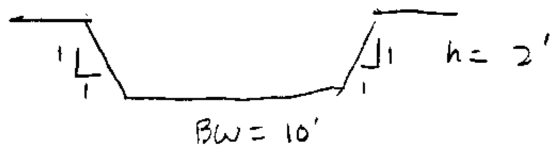
Q peak = 1.68 cfs to pond. Inlet 1 receives approx. 80% of this. ∴ flow in = 1.34 cfs.

resulting depth = 0.11 ft. OKAY
resulting velocity = 7.34 ft/s OKAY since the inlet is grouted riprap.

* Inlet 2 : North End of Pond

min Slope = max Slope = 4'/13' = .31

Q in = 0.34 cfs



resulting depth = .02 ft OK
resulting velocity = 1.72 ft/s OK

Velocity considered non-erosive.

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: POND B

Comment: POND B INLET #1

Solve For Depth

Given Input Data:

Bottom Width.....	1.50 ft
Left Side Slope..	1.40:1 (H:V)
Right Side Slope.	1.40:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.6700 ft/ft
Discharge........	1.34 cfs

Computed Results:

Depth............	0.11 ft
Velocity.........	7.34 fps
Flow Area........	0.18 sf
Flow Top Width...	1.81 ft
Wetted Perimeter.	1.88 ft
Critical Depth...	0.27 ft
Critical Slope...	0.0325 ft/ft
Froude Number....	4.07 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: POND B

Comment: POND B INLET #2

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n......	0.035
Channel Slope....	0.3100 ft/ft
Discharge........	0.34 cfs

Computed Results:

Depth............	0.02 ft
Velocity.........	1.72 fps
Flow Area........	0.20 sf
Flow Top Width...	10.04 ft
Wetted Perimeter.	10.06 ft
Critical Depth...	0.03 ft
Critical Slope...	0.0560 ft/ft
Froude Number....	2.16 (flow is Supercritical)

Sediment Pond "C" Calculations

REGISTERED PROFESSIONAL ENGINEER
No. 7900
KIMLY C. MANGUM
STATE OF UTAH

SED POND C

Soil Erosion to Pond "C"

Use the modified Universal Soil Loss Equation:

$$A = R \cdot K \cdot LS \cdot VM$$

Ref: Israelson, C.E., J.E. Fletcher, F.W. Haws, E.K. Israelson, 1984. Erosion and Sedimentation in Utah: A Guide for Control. Utah Water Research Laboratories, Logan, Utah.

A = Amount of soil loss per unit area
R = Rainfall Factor
K = Soil Erodibility Factor
LS = Topographic Factor
VM = Erosion control factor:
= 1.2 for bare, copmacted soil
= 0.1 for Seedlings, Brush

For Pond "C" ——▶

R = 16 ft-tons/acre/Hr.
(Mean annual R value from Figure 1, (Israelson et al, 1984))

K = 0.1 tons/Ac/EI (Israelson et al, 1984)

$$LS = \left(\frac{650 + 450s + 65s^2}{10{,}000 + s^2}\right) \cdot \left(\frac{l}{72.5}\right)^m$$

l = slope length
s = Slope steepness

m = 0.2 for $0 < s < 1$ %
0.3 for $1 < s < 3$
0.4 for $3 < s < 5$
0.5 for $s > 5$

Drainage Area	Slope Length l (ft.)	Slope s (%)	LS	VM	A	Area (Acres)	A(*) (ft³/yr)
AD-15	400	7.5	1.79	1.2	3.44	1.84	126

(*)assume 100 lb/ft³ unit soil wt.

Total Sediment Volume = 126 ft³

Design Events

2 Year - 6 Hour		P = 1.0
10 Year - 6 Hour		P = 1.5
10 Year - 24 Hour		P = 2.1
25 Year - 6 Hour		P = 1.8
25 Year - 24 Hour		P = 2.7

For 10 year - 24 hour storm, P = 2.1 in.

Curve Numbers

Disturbed area - CN = 90

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad S = \frac{1000}{CN} - 10$$

Watershed	CN	S	Q (in)	Area (Ac)	Runoff Vol. (ft³)
AD-15	90	1.11	1.18	1.84	7,881

Total Runoff Volume = 7,881 ft³

To allow a 5 year factor of safety for sediment storage:

Sediment volume = 630 ft³

Total Pond Volume = 8,511 ft³

Quick TR-55 Version: 5.45 S/N: 1315430158

>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<

Pond "C" Peak Discharge

CALCULATED
DISK FILE: POND-C .GPD

Drainage Area	(acres)	1.84	--->	0.0029 sq.mi.
Runoff Curve Number	(CN)	90		
Time of Concentration,Tc	(hrs)	0.09		
Rainfall Distribution	(Type)	II		
Pond and Swamp Areas	(%)	4.46	--->	0.1 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	10	25	10
Duration (hours)	24	6	6
Rainfall, P, (in)	2.1	1.8	1.5
Initial Abstraction, Ia (in)	0.222	0.222	0.222
Ia/p Ratio	0.106	0.123	0.148
Unit Discharge, * qu (csm/in)	1038	1033	1024
Runoff, Q (in)	1.18	0.93	0.68
Pond & Swamp Adjustment Factor	0.75	0.75	0.75
PEAK DISCHARGE, qp (cfs)	2.66	2.09	1.51

Summary of Computations for qu

Ia/p	#1	0.100	0.100	0.100
C0	#1	2.553	2.553	2.553
C1	#1	-0.615	-0.615	-0.615
C2	#1	-0.164	-0.164	-0.164
qu (csm)	#1	1040.188	1040.188	1040.188
Ia/p	#2	0.300	0.300	0.300
C0	#2	2.465	2.465	2.465
C1	#2	-0.623	-0.623	-0.623
C2	#2	-0.117	-0.117	-0.117
qu (csm)	#2	974.755	974.755	974.755
* qu (csm)		1038	1033	1024

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
  If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^{2})$$

$$qp\ (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond\ \&\ Swamp\ Adj.)$$

Pond C - As-built Structure

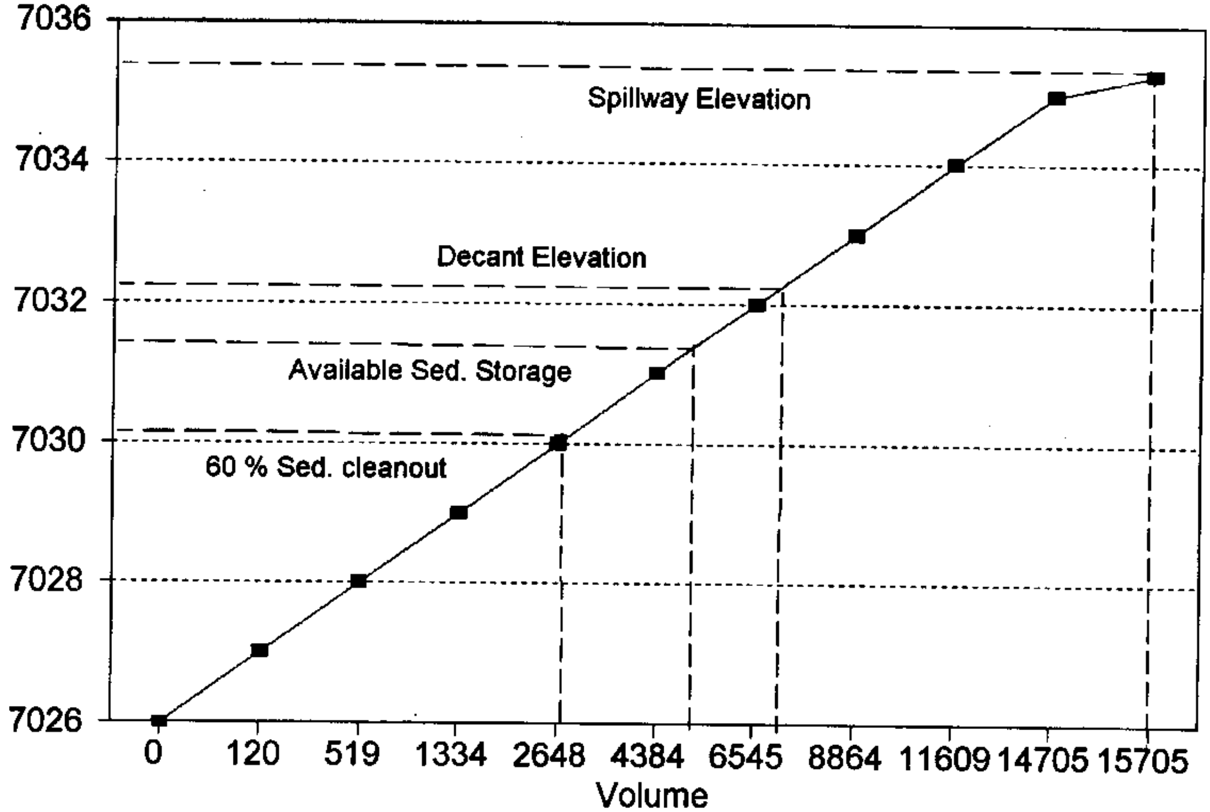
Stage - Area data

Elev. (ft.)	Area (ft^2)	Vol (ft^3)	cumulative Vol. (ft^3)
7026	22	0	0
7027	218	120	120
7028	579	399	519
7029	1,051	815	1,334
7030	1,578	1,315	2,648
7031	1,894	1,736	4,384
7032	2,245	2,070	6,545
7033	2,576	2,411	8,864
7034	2,914	2,745	11,609
7035	3,278	3,096	14,705
7035.3	3,390	1,000	15,705

Maximum volume below the emergency spillway is 15,705 cubic feet. The required volume for the 10 year - 24 hour storm event is 8,511 cubic feet. Therefore, the structure will contain the required storm event.

POND C

Stage - Capacity Curve



Outlet Structures

The proposed outlet structures will consist of a 4" decant and an emergency spillway in the form of a tapezoidal rip-rapped channel. The dimensions of the channel are shown on plate 7-6.

The combined outlets must pass the 25 Year - 6 Hour storm.

Outlet Calculations

Drainage area = 2.1 acres
Runoff CN = 90
Time of Concentration = 0.09 hrs.
Distribution = SCS Type II
Pond area = 0.09 acres
Precipitation, 25 Year - 6 Hour = 1.8 in.

From Table 4-1 (SCS TR-55), I_a = 0.222.

$I_a/P = 0.1233$

Unit **Discharge:**

$$\mathrm{Log}(Qu) = C_0 + C_1 \log(Tc) + C_2[\log(Tc)]^2$$

Where:
- Qu = Unit peak discharge (csm/in)
- Tc = Time of concentration (hr)

C_0, C_1, C_2 = Coefficients from Table F-1 (SCS TR-55)

Qu = 1032.36 csm/in.

Peak Discharge:

Qp = Qu*A*Q*Fp

Where:
- Qp = Peak discharge (cfs)
- Qu = Unit discharge (csm/in)
- A = Drainage area (qs.mi.)
- Fp = Pond and swamp adjustment factor (Table 4-2, SCS TR-55)
- Q = Runoff from 25 Year - 6 Hour = 0.93 cfs

Assuming the pond is full at the time of occurrence of the 25 year - 6 hour event, the worst case scenario is that the emergency outlet will receive a total flow of 2.09 cfs (With the decant closed).

FLOWMASTER was used to check the adequacy of the outlet design.

Inlet Design

The adequacy of the inlet design was checked for the 10 Year - 24 Hour event using FLOWMASTER.

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: POND C

Comment: POND C INLET

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n......	0.033
Channel Slope....	0.2000 ft/ft
Discharge........	2.66 cfs

Computed Results:

Depth............	0.19 ft
Velocity.........	6.03 fps
Flow Area........	0.44 sf
Flow Top Width...	2.58 ft
Wetted Perimeter.	2.70 ft
Critical Depth...	0.35 ft
Critical Slope...	0.0263 ft/ft
Froude Number....	2.57 (flow is Supercritical)

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: POND C

Comment: POND C OUTLET

Solve For Depth

Given Input Data:

Bottom Width.....	5.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n......	0.033
Channel Slope....	0.3000 ft/ft
Discharge........	2.09 cfs

Computed Results:

Depth............	0.09 ft
Velocity.........	4.71 fps
Flow Area........	0.44 sf
Flow Top Width...	5.26 ft
Wetted Perimeter.	5.31 ft
Critical Depth...	0.17 ft
Critical Slope...	0.0297 ft/ft
Froude Number....	2.86 (flow is Supercritical)

References:

Haestad Methods, Inc. 1991. FlowMaster I - User's Manual. Waterbury, Connecticut.

U.S. Soil Conservation Service, 1986. Urban Hydrology for Small Watersheds, Technical Release 55. United States Department of Agriculture, Washington, D.C.

Haestad Methods, Inc. 1989. Quick TR-55, Hydrology for Small Watersheds. Michael K. Glazner. Waterbury, Connecticut.

SEDIMENT POND “D”

Sediment Pond "D" Calculations

Sediment Pond "D" is designed to contain and treat the runoff for the Wild Horse Ridge Blind Canyon Seam portal pad (Bear Canyon No. 3 Mine). The pond is designed to contain the runoff from the 10-year 24-hour storm event in accordance with R645-301-742.220. The area is shown on Plate 7-5A, designated as area AD-18.

1 Soil Erosion to Pond "D"

Use the modified Universal Soil Loss Equation: A = R x K x LS x VM

Ref: Israelson, C.E., J.E. Fletcher, F.W. Haws, E.K. Israelson, 1984. Erosion and Sedimentation in Utah: A Guide for Control. Utah Water Research Laboratories, Logan, Utah.

A = Amount of soil loss per unit area
R = Rainfall Factor
K = Soil Erodibility Factor
LS = Topographic Factor
VM = Erosion control factor: = 1.2 for bare, compacted soil
= 0.1 for Seedlings, Brush

For Sediment Pond "D"

R= 16 ft-tons/acre/Hr. [Mean annual R value from Figure 1, (Israelson et al, 1984)]
K = 0.1 tons/ Ac/EI (Israelson et al, 1984)

$$LS = \left(\frac{650 + 450s + 65s^2}{10,000 + s^2}\right) \cdot \left(\frac{l}{72.6}\right)^m$$

l = slope length
s = slope steepness

m = 0.2 for 0 < s < 1 %
0.3 for 1 < s < 3 %
0.4 for 3 < s < 5 %
0.5 for s > 5

Drainage Area	Hyd. Length	Slope s (%)	LS	VM	A	A[a] (ft^3 / yr)
AD-18	770	3.16	0.70	1.2	1.34	24 ft^3/yr

[(a)] assume 100 lb/ft^3 unit soil wt.

To allow a 5 year factor of safety for sediment storage:

Sediment Volume = 270 ft^3

2 Peak design capacity

The pond is designed to contained the runoff from the 10-year 24-hour storm event. The outlet structures will be designed to pass the volume from a 25-year 6-hour storm event.

For Bear Canyon:

10 Year - 24 Hour	P = 2.1 in.
25 Year - 6 Hour	P = 1.8 in.

Curve Numbers: Disturbed Area - CN = 90

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad S = \frac{1000}{CN} - 10$$

Area	CN	S	Qu (in)	Area (acres)	Runoff Vol. (ft^3)
AD-18	90	1.11	1.18	0.9	3,855

Total Runoff volume = 3,855 ft^3
Total pond volume required for runoff and sediment = 4,125 ft^3

The proposed structure is shown on Plate 7-11. Following is the stage-capacity data for the proposed structure.

3 Stage - Capacity data

The following table presents the stage-volume data for the proposed structure.

Elev (ft)	Area (ft^2)	Vol (ft^3)	Cumulative Volume (ft^3)	
7644	42.20	0	0	
7645	208.65	125	125	
7646	467.98	338	463	
7647	825.02	646	1,109	
7648	1,274.70	1,050	2,159	
7649	1,962.65	1,619	3,778	
7650	2,871.97	2,417	6,195	
7650.5	3,243.73	1,529	7,724	Emergency spillway
7651.5	4,003.10	----	------	

The maximum volume below the emergency spillway is 7,724 cubic feet. The required volume for the 10 year - 24 hour storm event is 3,855 cubic feet, and the design sediment volume is 270 cubic feet, for a total design capacity of 4,125 cubic feet. Therefore, the structure will contain the required storm event. The maximum sediment capacity while still allowing for capacity of the design storm event is 3,869, which occurs near an elevation of 7649. To allow for an additional volume safety factor, the maximum sediment level will be set at 7647, allowing a sediment storage capacity of 1,109 ft^3. The primary spillway (decant) will be installed 1 foot above the maximum sediment level, at an elevation of 7648.

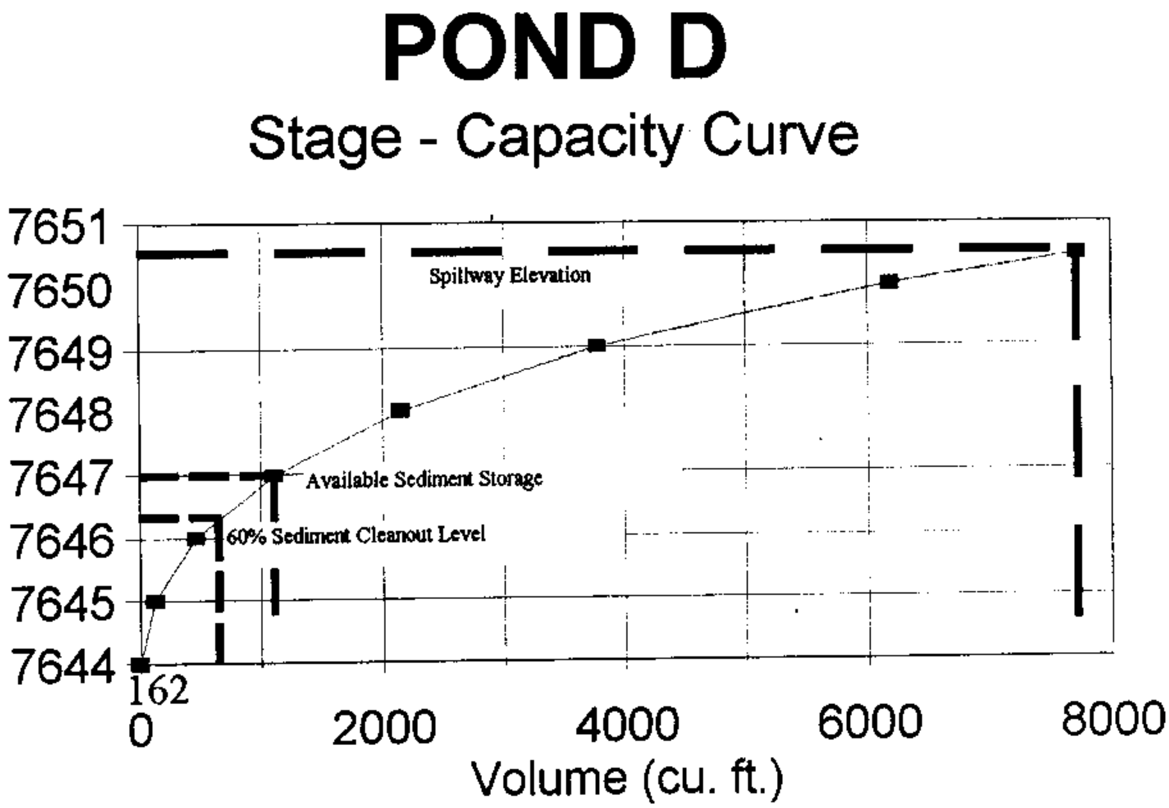
Sediment will be removed from the sediment pond in accordance with the plan presented in Appendix 3-K as soon as practical after it reaches 60% of the max design volume of 1,109 ft^3 .

The 60% Sediment Volume = 665 ft^3
The 60% Sediment cleanout elevation = 7,646.3

The decant elevation = 7,648

The volume above the decant = 5,565 ft^3.
10 - year 24 - hour storm volume = 3,855 ft^3

This will allow the pond to be decanted if necessary to a level to continue to allow for full containment of the design storm event.


POND D
Stage - Capacity Curve
7651
7650
7649
7648
7647
7646
7645
7644
Spillway Elevation
Available Sediment Storage
60% Sediment Cleanout Level
162
0
2000
4000
6000
8000
Volume (cu. ft.)

4 Inlet Design

The adequacy of the inlet design was checked for the 10 Year - 24 Hour event using *Peak and Flowmaster* software programs.

Area	CN	Area (acres)	Slope Y(%)	Hyd length (ft)	Time of Conc.
AD-18	90	0.9	3.2	771	0.170

The following table summarizes the hydrograph and peak flow calculations for the watershed. The *Peak* software program was used to determine the peak flow.

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-18

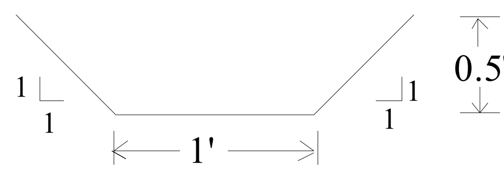
STORM:	WATERSHED:
Distribution = SCS Type 'II'	Curve Number = 90
Precip. Depth = 2.10 in	Time of Conc. = 0.1700 hr
Duration = 24.00 hr	Area = 0.90 ac

OUTPUT SUMMARY

Runoff depth = 1.1769 in
Initial Abstraction = 0.2222 in
Peak Flow = 1.03 cfs (1.1313 iph)
At T = 12.53 hrs

The inlet consists of a riprapped channel from Ditch D-16D (Plate 7-1G) into the sediment pond. Following is a cross-section of the inlet and the ditch calculation output. The inlet design was evaluated using *Flowmaster*.

Pond D Inlet cross-section



The slope of the channel inlet is 1'/3' = 0.33.

With a peak flow of 1.03 cfs, the resulting depth of flow = 0.14 ft.
The resulting velocity = 6.62 fps.

To prevent erosion, a grouted riprap will be used to line the inlet.

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Pond D Inlet
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.330000	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	100.00	V : H
Bottom Width	1.00	ft
Discharge	1.03	cfs

Results		
Depth	0.14	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.35	ft
Top Width	1.14	ft
Critical Depth	0.30	ft
Critical Slope	0.029640	ft/ft
Velocity	6.70	ft/s
Velocity Head	0.70	ft
Specific Energy	0.84	ft
Froude Number	3.22	
Flow Type	Supercritical	

Notes: Grouted Riprap

5 Outlet Design

The proposed outlet structures will consist of a 4" decant and an emergency spillway in the form of a tapezoidal rip-rapped channel. The dimensions of the channel are shown on Plate 7-11. The combined outlets must past the 25 Year - 6 Hour storm.

Outlet Calculations

Drainage area = 0.9 acres
Runoff CN = 90
Time of Concentration = 0.1700 hrs.
Distribution = SCS Type II
Pond area = included in drainage area
Precipitation, 25 Year - 6 Hour = 1.8 in.

The table below shows the calculated peak flow which must pass through the two outlets:

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-18 Pond Outlet Design

STORM:	WATERSHED:
Distribution = SCS Type 'II'	Curve Number = 90
Precip. Depth = 1.80 in	Time of Conc. = 0.1700 hr
Duration = 6.00 hr	Area = 0.90 ac

OUTPUT SUMMARY

Runoff depth = 0.9258 in
Initial Abstraction = 0.2222 in
Peak Flow = 2.07 cfs (2.2781 iph)
At T = 3.22 hrs

Flowmaster was used to evaluate the emergency spillway. Based on the following calculations, the emergency spillway will pass the entire flow from the 25 year - 6 hour event. Therefore, the outlet designs are adequate.

The resulting flow velocity = 8.04 fps, so 6" m.d. riprap will be used in the outlet.

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Pond D Outlet
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.330000	ft/ft
Left Side Slope	0.75	V : H
Right Side Slope	0.75	V : H
Bottom Width	1.00	ft
Discharge	2.07	cfs

Results		
Depth	0.20	ft
Flow Area	0.3	ft^2
Wetted Perimeter	1.67	ft
Top Width	1.54	ft
Critical Depth	0.42	ft
Critical Slope	0.022881	ft/ft
Velocity	8.12	ft/s
Velocity Head	1.03	ft
Specific Energy	1.23	ft
Froude Number	3.52	
Flow Type	Supercritical	

Notes: Riprapped Channel

6 Protection From Rapid Drawdown

In accordance with R645-301-553.300, Sediment Pond D cross-section A-A’ (shown on Plate 7-11) was analyzed for rapid drawdown stability. The analysis was conducted using a software program called SBSLOPE, released by the Office of Surface Mining.

The input data for the program was reviewed with Wayne Western, engineer for the Division of Oil, Gas & Mining. The program is not capable of printing the output, so the output results were visually confirmed by Wayne Western. The analysis resulted in a minimum safety factor of 1.36, which is greater than the required factor of 1.3.

References:

Haestad Methods, Inc. 1991. FlowMaster Open Channel Flow Module, Version 3.3. Waterbury, CT.

Israelson, C.E., J.E. Fletcher, F.W. Haws, E.K. Israelson, 1984. Erosion and Sedimentation in Utah: A Guide for Control. Utah Water Reserch Laboratories, Logan, Utah.

U.S. Soil Conservation Service, 1986. Urban hydrology for Small Watersheds, Technical Release 55. United States Department of Agriculture, Washington, D.C.